Lextran Retrofit/Upgrade Solution: Effectively controlling the emissions and the expenses

A recent analysis by McIlvaine Company identifies ten major challenges facing the power plants operators around the globe[1]. Top three are related to the coast effectiveness of the existing pollution controll systems and legal limitations posed on them by the governments, such as Clean Air Act (US), Air Toxic Rule (US), Air Pollution Prevention Law (PRC) and numerous European Council directives and resolutions. Flue gas treatment (FGT) has become a focus of electric utilities and industrial operations due to tightening air, water and soil quality standards. As companies seek to comply with the new regulations and to use more economical fuel sources, the need for innovative flue gas treatment options has grew to increase treatment efficiency and reduce total cost of ownership. These regulations will require coal-fired power plants that have not yet installed pollution control equipment to do so and, in some cases, will require plants with existing control equipment to improve performance.

In the United States (second largest coal burning electricity producer in the world) only 60% of the nation's coal fleet has already installed SOx scrubbers, the most capital intensive of the pollution control systems used by coal-fired power plants. Only a half has installed advanced post-combustion NO_x controls[2]. Hundreds of coal fired units with installed capacities in the range 50-300 MWe currently operating in the USA without SCR, FGD, or any other asidic gases control. These smaller units are a valuable part of the USA's power generation infrastructure, contributing about 60 GWe in total. However, with ever tightening emissions requirements (eg. CAIR, CAVR, possible mercury MACT standards and state regulations), pollution control retrofits will be required in many cases to allow these units to keep operating.

Air Pollution Control systems retrofits face many challenges, major ones being space constraints and the significant capital expenses of erecting at least two air control systems (FGD and SCR). First, all scrubber retrofits require an absorber tower and absorber tank, typically between 50 and 70 feet in diameter. Second, retrofit units will usually not use existing stacks, as these stacks are designed for hot flue gas approximately at a 100 ft/sec exit velocity. To accommodate saturated flue gas from wet FGD, wet stacks are designed for a highly corrosion-resistant material with a gas velocity of between 55 to 70 ft/sec. Lower gas velocity is required to prevent condensed moisture from being carried out the top of the stack. Third, the relining of the existing stack and installation of the new systems will require long down-time or frequent outages.

The most widely used and available FGD technology is the lime-FGD. However, while lime-FGD systems are the prevailing solution, technologically and environmentally it is outdated. The lime-FGD installations are space demanding, reagent transport require additional access roads and/or spare rail capacity, easily accessible landfills or dry boards producers, and the byproducts are potentially hazardous or useless waste.

Numerous environmental problems associated with the handling of the solid wastes and byproducts have arisen during the years of operation. Besides the solid and liquid waste, the processes also produces secondary air pollution since the reaction of SO_2 with the limestone ($CaCO_3$) produces gaseous CO_2 :

$$CaCO_3 + SO_{2\ (g)} \rightarrow CaSO_3 + CO_{2\ (g)} \uparrow$$

Moreover, the commercial profitability should be considered. At present, lime–FGD requires investment in the lime stone storage facilities, processing areas, gypsum post processing and loading facilities, access roads and the many acres required to host those. The clogging of the limestone apparatus and injection nozzles frequently lowers the efficiency of the system and further raises the operational costs.

The lime-FGD byproduct gypsum has for several reasons shown limited market potential and is largely being disposed off in landfills. The recycled gypsum might pose a threat since it might contain high volumes of mercury and other heavy metals. As occurred in many "contaminated dry-walls" cases[3] the hazardous materials find their way to our homes, schools and offices.

Coal contributes acidic gases, such as chlorides, fluorides and sulfate as well as volatile metals, such as arsenic, mercury, selenium, boron, cadmium and zinc which should be removed before discharge into any surface water. The mercury, being the major toxic metal present in the slurry requires further processing before commercial recycling or disposal are possible. Most lime-FGDs discharge wastewaters that are either slurry of waters, dissolved solids, and/or suspended solids laden with heavy metals and salts. For example, in most European countries the sludge water is classified as hazardous[4]. Therefore, in developing plans to install lime-FGDs, utilities must also develop a strategy for the associated wastewater treatment systems for the scrubber purge stream.

Figure 1. Ashes deposits on SCR catalyst surface

The de-NO_x technologies are lagging behind the current and future environmental and legislative demands. The current SCR systems suffer from several inherent technological and economical disadvantages, such as: rocketing SCR CapEx, SO_2 oxidation, honeycombs clogging (*Figure 1*)[5].

Lextran's Innovative Multi-pollutant Alternative

The future of the FGT technologies lies in new revolutionary technologies. The solutions must address three needs: cost effective hazardous air pollutants removal, no secondary pollution and recyclable commercially valuable by-products.

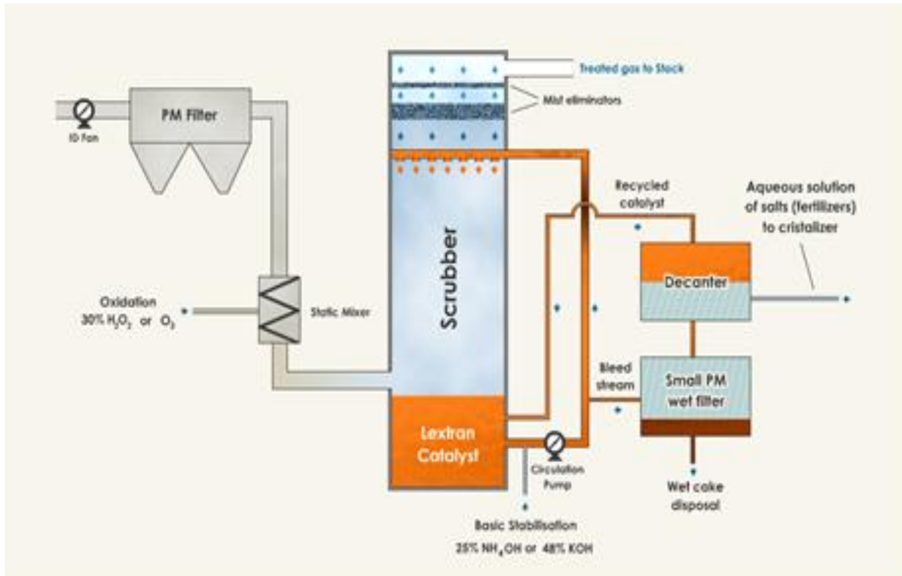

Figure 2. Schematic design of Lextran's WFGD-based operation. Removes NO_x and SO_x from flue gas and converts them into fertilizers.

For the existing units space limitations add another dimension to demands from emissions control technologies and a multi-pollutant approach (ie installation of a combination of technologies in an integrated and innovative way) is the most appropriate.

Lextran has developed a proprietary catalyst and process to be used in **existing open spray tower** that meets all the requirements. Our state of the art process offers comprehensive technological, financially beneficial and environmentally friendly solution. Existing conventional gas-liquid contacting absorption tower (scrubber) can be refurbished to disperse the Lextran reagent. There is **no need in extensive infrastructure changes** since our technology is based on the existing spray tower which only needs some reconstruction of the internal liquid transportation systems and can make use of some of the existing systems or auxiliary installations.

Lextran's integrated de-SNOx technology enables the absorption of the following pollutants from flue gases in <u>one single pass</u>:

Sulfur oxides (SO_x) - **removal of 99%, unconditional of entrance concentration.**

Nitrogen oxides (NO_x) - **removal of up to 95% of entrance concentration.**

The Lextran product, manufactures by a proprietary nano-technology based process, contains an active sulfur-oxygen functional group, having catalytic properties which enhance the oxidation reactions of SO_x and NO_x into SO_4 and NO_3 anions. The catalyst ends its role once a basic reagent is added to stabilize a byproduct that is typically a fertilizer.

Economical potential and cost-efficiency

After facilitating the initial oxidation, the Lextran catalyst is released and recycled back into the process leaving the pollutants in chemical form amenable to become commercially beneficial by-products (Fertilizers) with a further neutralization by ammonia, KOH, or other basic reagents to control the type of byproduct (*Figure 2*). The possible byproducts are therefore highly economically potent ammonium nitrate, ammonium sulfate, potassium sulfate, potassium nitrate, and others.

With a generic 30% cost of retrofitting an existing WFGD facility, additional saving on De-NO_x and less than 50% of the running costs, Lextran process introduces a dramatic saving compared with traditional dedicated facilities which have to be implemented sequentially. Once the investment in an open spray tower has been made, treating NOx is virtually for free. **Bottom line – cost saving of at least 40% in construction, and 50% in operational costs.**

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[1] http://home.mcilvainecompany.com/index.php?option=com_content&view=article&id=191

[2] Staudt J. E., "Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants", report for Northeast States for Coordinated Air Use Management, (Boston: Andover Technology Partners, March 2011).

[3] http://www.propublica.org/series/tainted-drywall

[4] Kikuchi R.," Alternative By-Products of Coal Combustion and Simultaneous SO_2/SO_3/NO_x Treatment of Coal-Fired Flue Gas: Approach to Environmentally Friendly Use of Low-Rank Coal", in Kenneth S. Sajwan et al. ed., *Coal Combustion Byproducts and Environmental Issues*, (New York: Springer, 2006), pp.23-24

[5] Cichanowicz J. E., Muzio L.G. et al., "The First 100 GW of SCR in the U.S. - What Have We Learned?" , Paper #129, available at: http://www.ferco.com/Files/Paper129.pdf